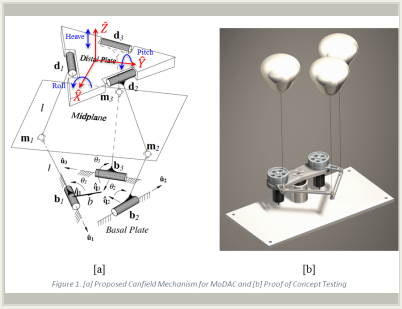
Momentum Device Actuated Canfield (MoDAC) Manipulator, Phase I

Completed Technology Project (2015 - 2015)

Project Introduction

Development of a robotic manipulator called Momentum Device Actuated Canfield (MoDAC) Manipulator for integration on to the assistive free flyers (AFF) being developed by NASA for the International Space Station is proposed. Integrating a robotic manipulator with an appropriate end-effector to an AFF provides the capability to perform several autonomous functions such as material handling, fetching and handling tools, procedural support to astronauts during their experiments, etc. Additionally, it can help the AFF to dock into battery charging stations and perch by grabbing on to rails or other features on the ISS. Some of the technical challenges posed by incorporating a traditional multi-degree of freedom manipulator on an object of small inertia such as the AFF include complexity in attitude control and rapid depletion of battery (or propellant) due to (a) reaction disturbances caused by a joint motion and (b) Variation in the inertia of the AFF-manipulator system caused by manipulator movement. Additionally, mass, volume, and control issues are posed by utilizing a serial multi-DOF manipulator. Development of a parallel kinematic manipulator with a disturbance-free actuation mechanism will improve the performance of the AFF's attitude control system. Additionally, a manipulator-embedded mass property estimation scheme will complement the task of controlling the AFFs position and attitude. The proposed MoDAC manipulator achieves these objectives by using a reaction wheel based actuation method for a modified Canfield mechanism. Additionally, the manipulator electronics are embedded with a manipulator-inertia estimation algorithm that is transmitted to the AFF in real time for superior attitude control. The Phase 1 effort will demonstrate the technical feasibility to perform disturbance-free manipulator operations suited for Assistive Free Flyers such as SPHERES and HET-2 via high-fidelity simulations and proof of concept prototype development and testing.



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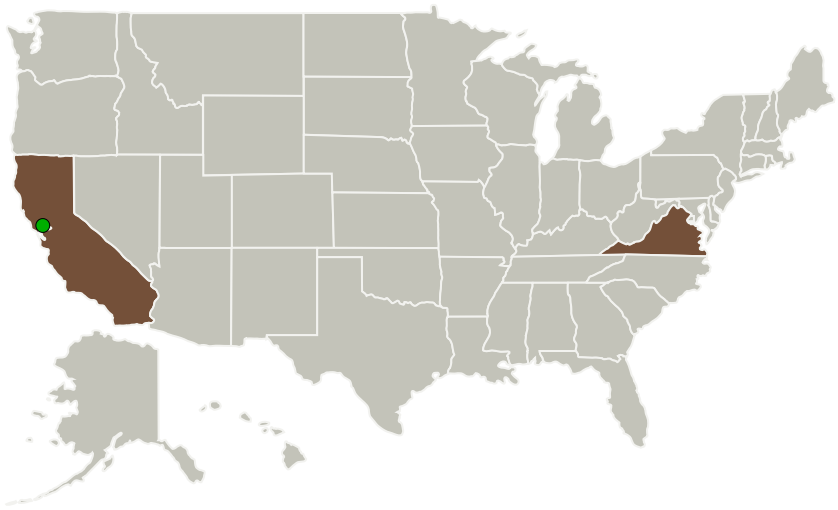
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Millennium Engineering and Integration Company	Lead Organization	Industry	Arlington, Virginia
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Virginia

Project Transitions

June 2015: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Millennium Engineering and Integration Company

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

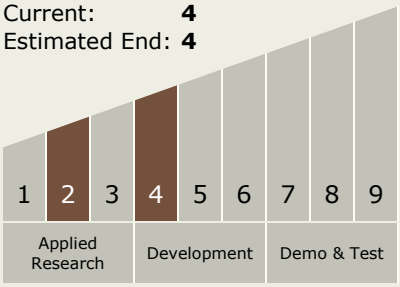
Carlos Torrez

Principal Investigator:

Andres Mora

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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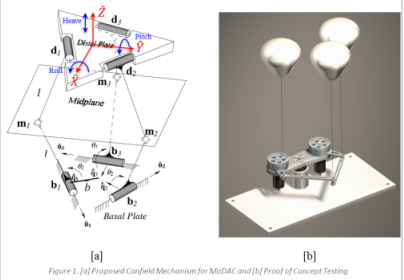
December 2015: Closed out

Closeout Summary: Momentum Device Actuated Canfield (MoDAC) Manipulato r, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/139250)*

Images



Briefing Chart Image
Momentum Device Actuated Canfield (MoDAC) Manipulator, Phase I
(https://techport.nasa.gov/image/135421)

Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.3 Manipulation
    - TX04.3.3 Contact Dynamics Modeling

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System